



FIRE TACTICS AND PROCEDURES HAZARDOUS MATERIALS 1

April 19, 2022

ALTERNATE FUELS

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1. Introduction

- 1.1 Environmental concerns and fuel conservation programs have caused industry to develop the use of alternate fuels such as Propane, Butane, Methanol, Compressed Natural Gas etc.
- 1.2 Section 1 of this bulletin deals with fires and emergencies in bulk transportation and storage of Propane and/or Butane.
- 1.3 Sections 2, 3 and 4 deal with alternate fueled vehicles as per the following:
 - 1.3.1 Section 2 - Propane fueled vehicles
 - 1.3.2 Section 3 - Compressed Natural Gas fueled vehicles (CNG)
 - 1.3.3 Section 4 - Methanol fueled vehicles

2. BULK TRANSPORTATION AND STORAGE OF PROPANE AND BUTANE

2.1 Introduction

The expanded use of LP gas increases the potential for fires and/or leaks in LP gas containers. These containers include storage tanks in commercial installations, tank trucks, railroad tank cars and portable storage tanks.

- 2.1.1 The term LP refers to Liquefied Petroleum Gases, which are stored as a liquid under pressure but vaporize into a gas when the pressure is released. They are also referred to as "LPG" or "Bottled Gas". They are generally composed of propane, butane or some combination thereof.
- 2.1.2 LP gases are used in domestic or industrial heating, hot water and cooking systems, as refrigerants, at construction sites in salamanders, in torches, tar pots, etc. They are also used on a limited scale as a motor fuel.

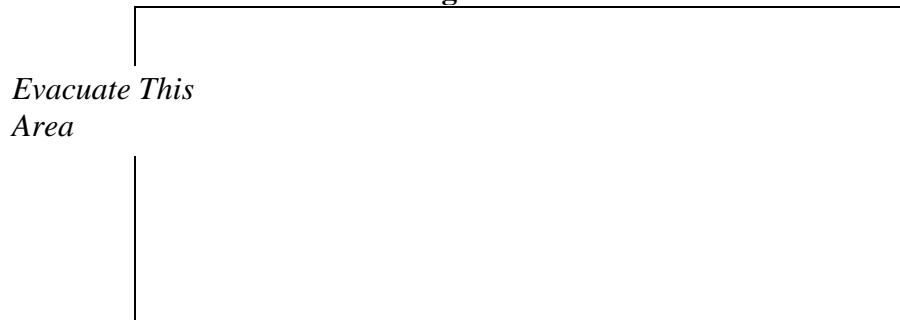
2.2 Properties

- 2.2.1 LP gases are non-toxic and non-poisonous. They are however slightly anesthetic. When inhaled over a long period of time, LP gas will cause headache or nausea. Asphyxiation can occur due to oxygen displacement.
- 2.2.2 LP gas is odorless, an odorizing agent is added only when it is processed for domestic consumption.
- 2.2.3 LP gas is flammable.
- 2.2.4 In the liquid state, LP gases present a hazard similar to a highly volatile flammable liquid but with more rapid vaporization.
- 2.2.5 LP gases are heavier than air (1.5 to 2 times heavier).

2.3 Basic Precautions to be Taken at LP Gas Fires and Emergencies

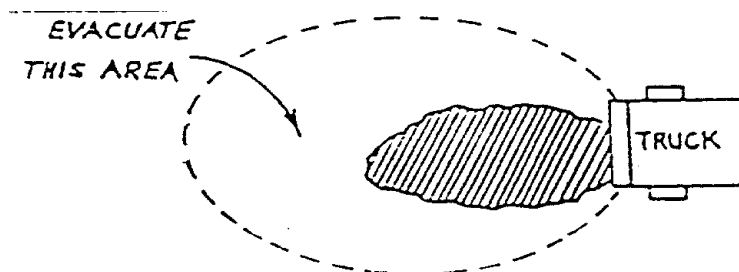
- 2.3.1 Whenever possible, approach the fire or leak from up-wind. Keep nozzle low and aim it upward to disperse gases or flaming vapors. Use multiple lines where necessary.

Figure 1



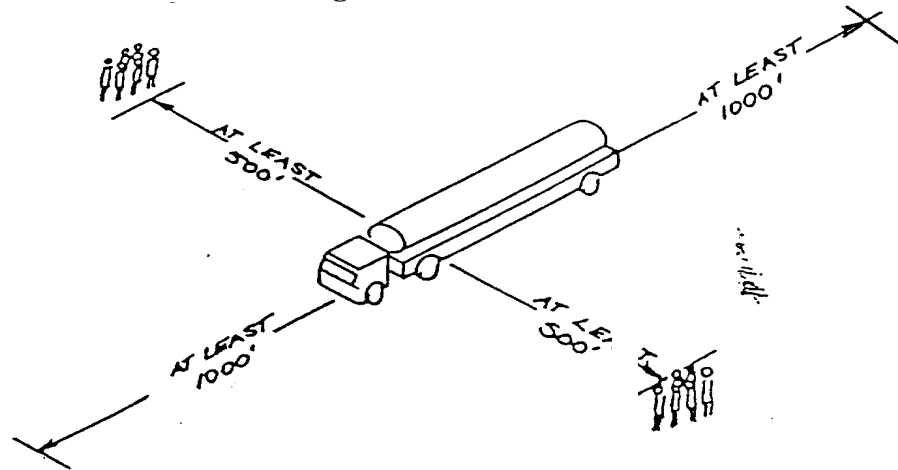
- 2.3.2 Clear all Persons out of the vapor cloud area, evacuate areas in the path of the vapor cloud immediately. Shut off all sources of ignition at the same time. Keep in mind that LP gas is heavier than air.

Figure 2



- 2.3.3 Keep everyone, not actually engaged in operations, at least 1000 feet from the front and rear of the tank and 500 feet from the sides.

Figure 3

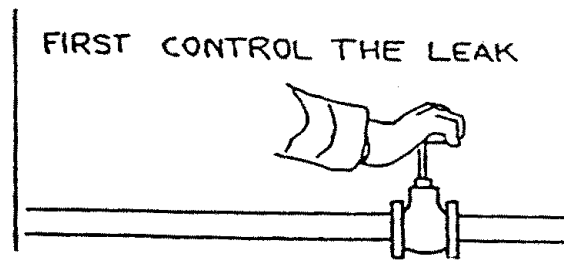


- 2.3.4 If not present, call for police assistance to establish and maintain safety zone. if necessary, call for Haz Mat Unit, Rescue Company and additional Fire Department Units. However, keep operating personnel to a necessary minimum.

2.4 Operations at a Leak With a Fire

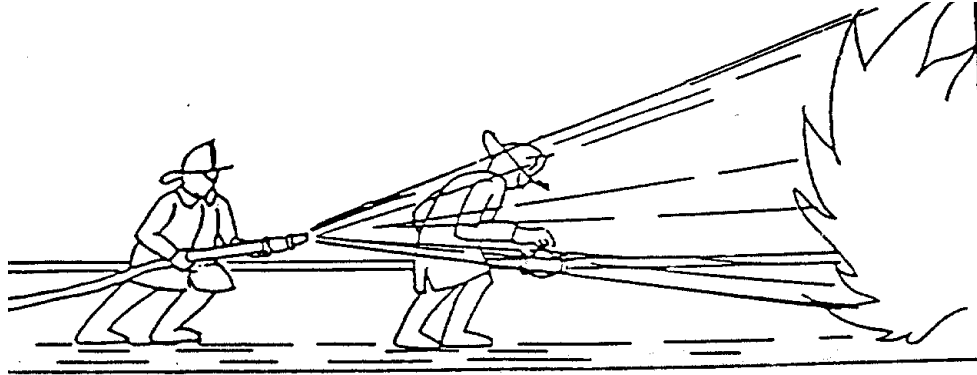
- 2.4.1 Do not extinguish the fire until the leak has been stopped, except under extremely unusual conditions.

Figure 4



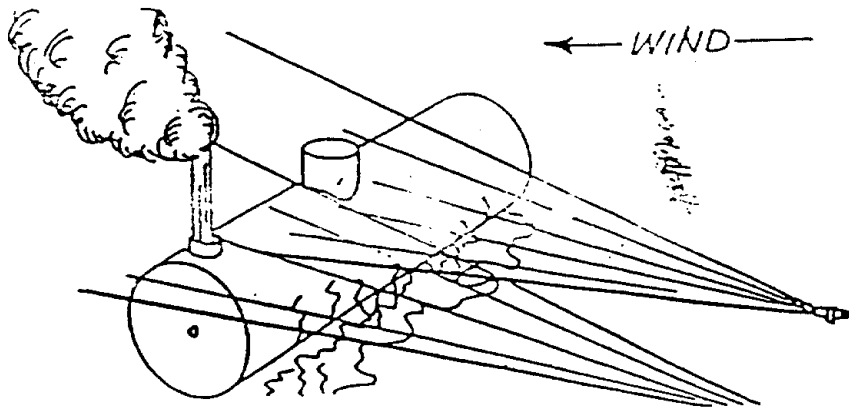
- 2.4.2 If the only valve that can be used to stop the flow of gas is involved in fire or is exposed to heat or flame, consider the possibility of using a heavy fog stream to protect member while they shut off the valve. Proceed slowly to prevent flashback which may entrap the member in flames. Members involved should wear masks and protective fire clothing.

Figure 5



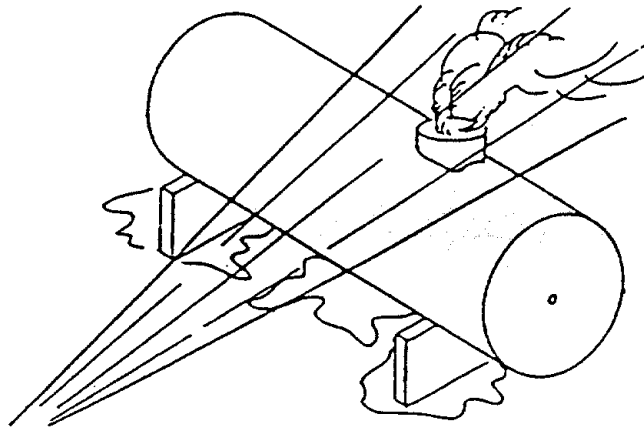
- 2.4.3 Tank surfaces that are exposed to heat, either from auto exposure or fire from another source, can be protected by supplying large quantities of water on them. Approach the tank from the sides, applying water to all exposed surfaces as well as piping and valves.

Figure 6



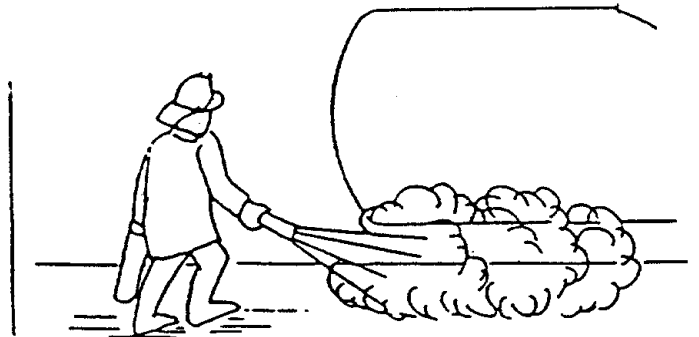
- 2.4.4 Consult chauffeurs, operating personnel or any qualified person regarding methods of stopping the flow of gas or any pertinent information that may assist our operations.
- 2.4.5 Where escaping gas is on fire and the flow cannot be shut off, application of large quantities of water on the tank and piping will permit controlled burning, allowing the fire to consume the contents of the tank without the danger of tank or pipe failure. Make certain that fire is NOT extinguished.

Figure 7



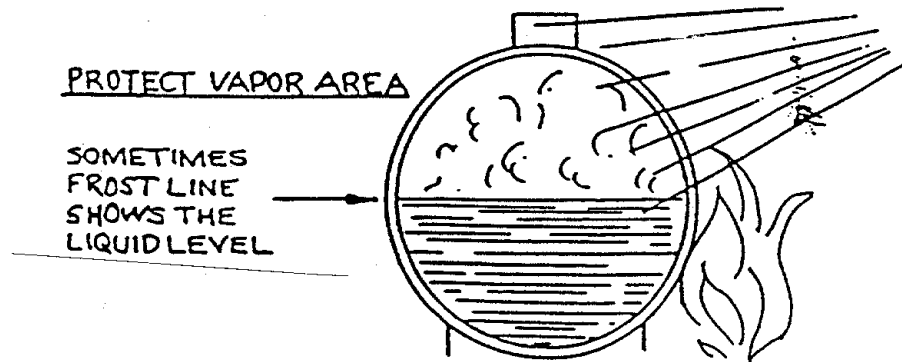
- 2.4.6 Portable dry chemical extinguishers are effective on small LP gas fires. Carbon dioxide extinguishers can also be used. They should be applied at the base of the fire.

Figure 8



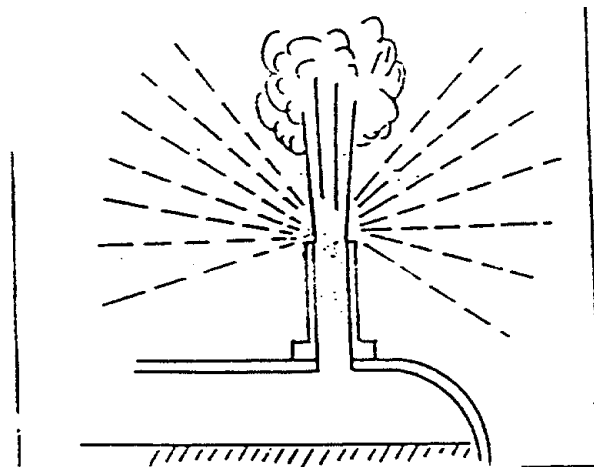
- 2.4.7 Tank failure under fire conditions usually occurs in the vapor area of the tank when sufficient water cannot be applied to prevent the metal from softening or weakening to a point where metal failure occurs.

Figure 9



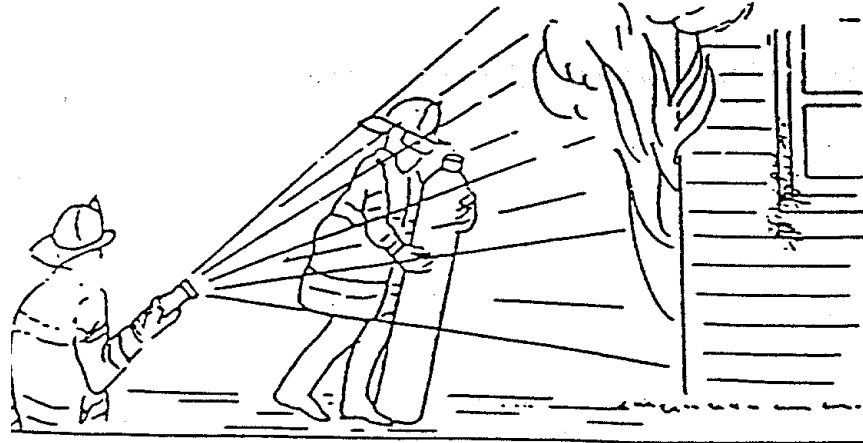
- 2.4.8 Before tank failure occurs, the rise in pressure within the tank will cause an increase in the volume of fire, or a rise in the noise level or both. This may or may not be accompanied by a bubble or blister forming on the tank shell. When any of these symptoms are present, the operating forces should be withdrawn to a safe area.

Figure 10



- 2.4.9 Ordinarily no attempt should be made to move a tank involved in a fire. Usually little would be gained in reducing the hazard. However, if specific conditions develop that make it desirable to move the tank, it should be moved in an upright position. Never drag it in a manner that might further damage valves or piping. Any attempt to turn the tank upright, to remove it to some remote location or to facilitate product withdrawal, should be done carefully to avoid damage to valves and piping. Portable LP gas cylinders that are exposed to a serious fire should be removed to a safe location.

Figure 11



2.5 LP Gas Leak Without Fire

- 2.5.1 If escaping LP gas is not on fire, close any valve available that can stop the flow of gas. Small lines such as copper tubing could be flattened to stop the flow. If an LP gas vehicle is involved, consult the driver; or if storage facilities are involved, consult plant personnel regarding possibilities of shutting off leaks.

Figure 12

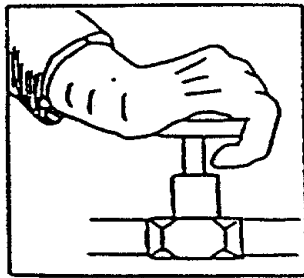
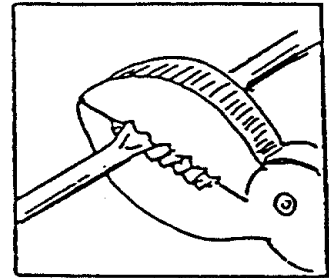
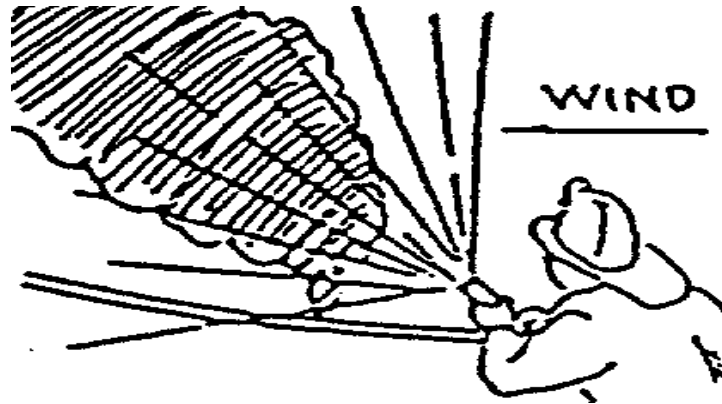


Figure 13



- 2.5.2 Water spray is effective in dispersing LP gas vapor. It should be used as soon as possible, directing the spray stream across the normal vapor path and dispersing the vapor to a safe location. Members handling the hose should avoid entering the vapor cloud and should keep low behind the spray so that they will be somewhat protected from radiant heat if the vapor should be ignited unexpectedly.

Figure 14



- 2.5.3 If water spray is not effective in dispersing the LP gas vapor, then heavy streams of water should be used from a safe distance.

3. PROPANE FUELED VEHICLES

3.1 Introduction

3.1.1 Mostly found in dual-fueled vehicles which has both gasoline and propane. These vehicles (buses, vans and autos) could be found anywhere in the city.

3.2 Identification

3.2.1 Various signs or placards may be found on these vehicles (Figures 16, 17, 18, 19).

3.2.2 Finding a propane cylinder installed in a vehicle would be a positive means of identification.

3.3 Properties

3.3.1 Propane is a Liquefied Petroleum Gas (LPG), and has the properties indicated in Section 2.2.

3.4 Inherent Hazards

3.4.1 Propane is a liquefied gas stored in cylinders at a temperature above its boiling point and remains under pressure and in liquid form only so long as the container remains closed to the atmosphere.

3.4.2 Heat applied to the cylinder will cause excessive pressure to build up in the cylinder opening the relief valve. One cubic foot of liquid will expand 270 times as a gas.

3.4.3 There is a great possibility that a cylinder involved in a fire will "BLEVE" (Boiling Liquid Expanding Vapor Explosion). A BLEVE can occur in a matter of minutes. A satisfactory performance of a relief valve can not prevent a BLEVE.

* More information on BLEVES may be obtained from "WNYF- 4/77 and the Fire Protection Handbook 16th Edition, Section S, Chapter 3.

3.4.4 An impact failure of a cylinder in a transportation accident can also cause a BLEVE.

3.4.5 When a BLEVE occurs in a propane cylinder it will usually result in an explosion and fire ball with the cylinder becoming a flying missile.

Figure 16



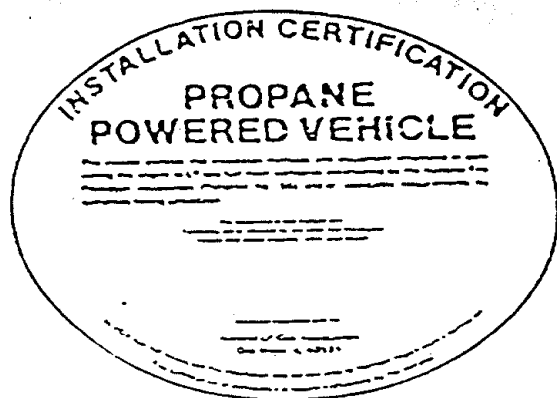
Figure 17



Figure18



Figure 19



3.5 Operational Guidelines

3.5.1 Leaks/Spills

- A. Eliminate sources of ignition
- B. Evacuate immediate area:
 - 1. Down-wind.
 - 2. Low areas (cellars etc.)
 - 3. Evacuate first where the life hazard is the greatest.
 - 4. Expand evacuation as necessary.
- C. Use fog streams to channel vapors.
- D. Control the leak - close valve etc.
- E. Utilize the combustible gas detector (carried by some Battalions, Rescue Companies and Haz-Mat).

3.5.2 Fires

- A. Evacuate as per Section 2.5.1
- B. Do not extinguish the fire unless the leak can be stopped. Protect exposure with hose streams.
- C. Cylinders exposed to fire and heat shall be cooled by hose streams to prevent a BLEVE.

3.6 Safety Considerations for Controlling Leaks and Fires

3.6.1 Areas of Exposure

- A. The three areas of exposure during a vehicle leak or fire in a propane (LP-Gas) system are:
 - 1. The engine compartment.
 - 2. The fuel line from the tank to the automatic shutoff valve.
 - 3. The tank area.

- B. Many vehicles are dual-fueled and use both propane and gasoline alternatively. A fire can originate with a gasoline leak and may eventually involve both fuels. A BASIC PRINCIPLE IS THAT A PROPANE FIRE SHOULD NOT BE EXTINGUISHED EXCEPT BY SHUTTING OFF THE FLOW OF ESCAPING PROPANE.
- C. It is important that we extinguish the gasoline fire by using foam, dry chemical or water spray and at the same time cooling the propane cylinder with hose streams to prevent a BLEVE.

3.6.2 The Engine Compartment

- A. Propane components in the engine compartment normally consist of the following:
 1. The Automatic Shutoff Valve.
 2. The Vaporizer-Regulator.
 3. The Mixer or Carburetor.
 4. The connecting high pressure hose.
- B. The following diagram depicts a typical propane system.

Figure 15

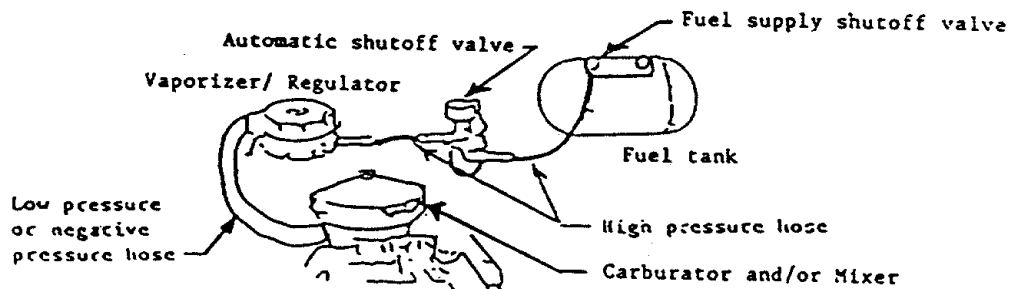


Figure 15

- C. If a propane leak or fire occurs in the engine compartment, it can be controlled by stopping the engine and shutting off the supply valve on the fuel tank. The fuel shutoff valve can be turned off by turning it CLOCKWISE. Remember, even though the supply valve has been shut off, the fuel line still contains propane. It will take a period of time for the leak or fire to stop, depending on the size of the fuel line and leak. (Figure 20)

3.6.3 Fuel Line From Tank To Automatic Shutoff Valve

- A. The fuel line will normally be stainless steel wire braid reinforced hose however, it could be copper tubing. The fuel line usually follows the frame of the vehicle and must be secured in such a manner as to give protection from excess heat or physical damage.
- B. If the fuel line from the fuel tank to the automatic shutoff valve should develop a leak, shut off the fuel tank valve. If gas is being released and cannot be shut off with the tank valve, a fog stream of water directed at the point of the leak will disperse the gas.

3.6.4 The Tank Area

- A. This area will vary depending on type of vehicle. The tank might be mounted in the trunk, under the skirt of a van school bus mounted to the frame or in bed of a pickup truck. (Figures 21, 22, 23 and 24)
- B. If the tank area is involved in a fire, immediately locate where the tank relief valve discharges and keep clear of this area. Should the relief valve function and discharge gas, the resulting discharge and possible fire could harm personnel. Direct water fog on the tank's outer surface to keep it cool from the heat or flame impingement.
- C. The discharge point of the relief valve on passenger cars are positioned within 45 degrees of vertical. This could be located on top of the trunk or in the rear quarter panel or possibly off the rear bumper. (Figure 23)
- D. If you cannot find the discharge point of the relief valve on the exterior of the vehicle, under cover of water fog open the trunk to get at the fuel tank, then turn off the supply valve and apply water to the container.
- E. When the discharge point is on the exterior of the vehicle, away from where the trunk can be opened, then you can open the trunk to either turn off the supply valve or apply water to the container depending on the situation you have encountered.
- F. Vans, trucks and buses have containers located in the rear section of the vehicle or mounted under the skirt or frame. The relief valve discharge must be piped to a safe area. (Figures 21, 22, and 24)
- G. Determine the discharge point of the relief valve and keep all personnel away from this discharge point.

Figure 20

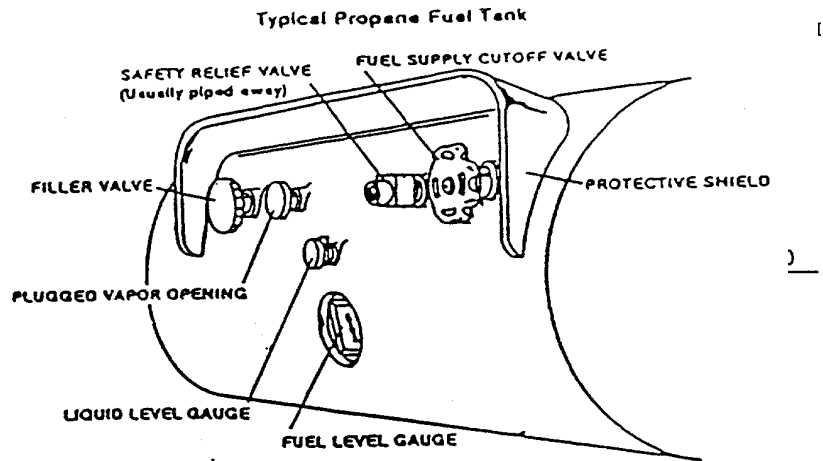
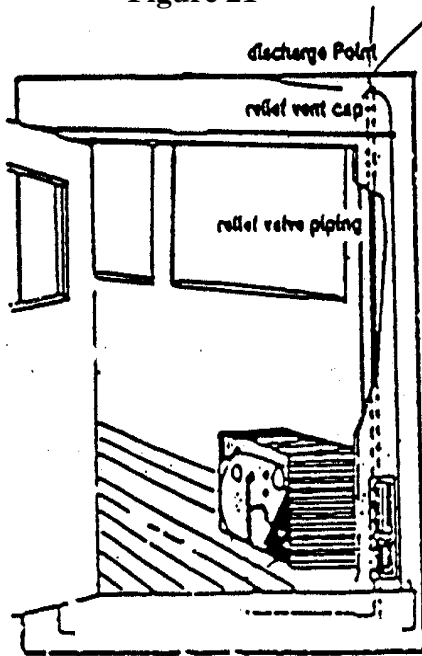
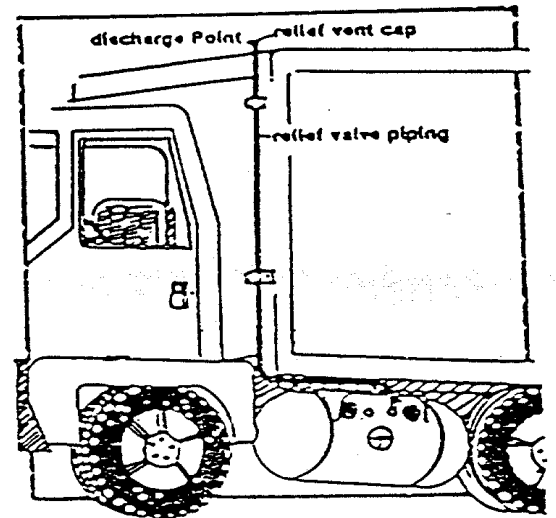


Figure 21



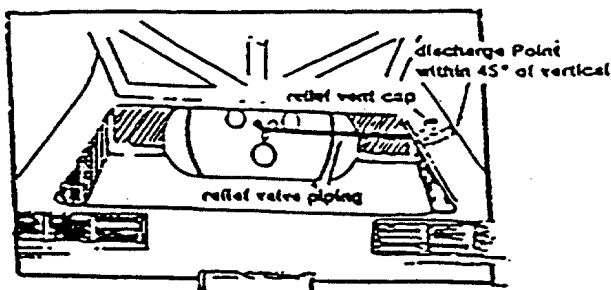
VAN TYPE VEHICLE

Figure 22



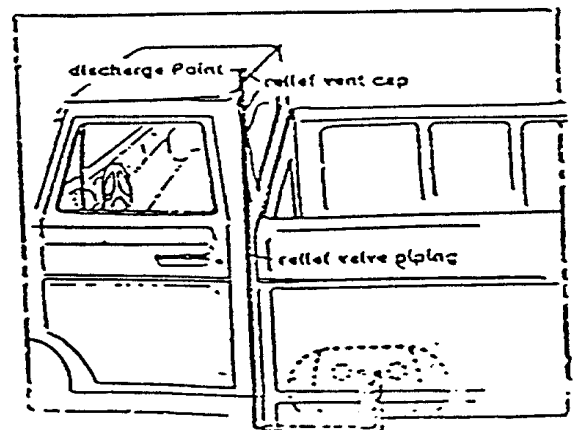
STAKE OR BOX TYPE TRUCK

Figure 23



PASSENGER VEHICLE

Figure 24



UNDER SKIRT PICKUP TRUCK

4. COMPRESSED NATURAL GAS (CNG) FUELED VEHICLES

4.1 Introduction

4.1.1 The Brooklyn Union Gas Company, in conjunction with the Command Bus Company of Brooklyn, has been running a pilot program using CNG fueled buses since 1987. These buses are refueled from a street main with a compressor. The buses are stored outdoors at the Command Bus garage located at 626 Wortman Avenue, Brooklyn. Each cylinder contains 1100 cubic feet of gas and each bus carries nine (9) aluminum cylinders. (Figure 28)

4.1.2 Brooklyn Union Gas (BUG) operates 200 dual fueled vehicles (sedans, vans or trucks). Most vehicles are gasoline - CNG combinations. A small number are diesel - CNG or CNG only. Each vehicle carries from one to four CNG cylinders. (Figure 25)

A. Brooklyn Union Gas refueling stations are located at:

1. Greenpoint Plant - Maspeth Ave., Brooklyn
2. Canarsie Plant - Ralph Ave. and Ditmas Ave., Brooklyn
3. Staten Island Snug Harbor, Staten Island (Under construction)

B. See Figure 26 for a typical CNG refueling station.

4.1.3 Units shall be aware that CNG fueled vehicles have progressed past the experimental testing stage. These vehicles are ideal for local intracity operations. The United Parcel Service and the NYC Department of Sanitation are beginning to use these vehicles.

4.2 Identification

4.2.1 All vehicles powered by Compressed Natural Gas (CNG), which require a Fire Department permit to operate using such fuel, are required to have a warning placard on their front and rear bumper. Identification number 1971 in the diamond indicates that compressed natural gas is being used for propulsion. All other CNG powered vehicles registered in the state of New York are likely to be placarded only on the rear bumper. Vehicles originating outside of New York State are likely to be placarded in accordance with their applicable state regulations.

Note: There may be some states that do not require CNG powered vehicles to have any warning placard.

4.3 Properties

- 4.3.1 Natural gas is flammable.
- 4.3.2 Natural gas is non-toxic. Asphyxiation can occur due to oxygen displacement in an enclosed area.
- 4.3.3 Natural gas is lighter than air.
- 4.3.4 Natural gas is composed of 95% Methane and 5% other gases. The two terms Natural Gas and Methane are used interchangeably.

4.4 Inherent Hazards

- 4.4.1 CNG - is pressurized in cylinders up to a pressure 3,000 PSI.
- 4.4.2 CNG cylinders are protected with a fusible plug pressure relief device which will open when a cylinder is exposed to heat or fire.
- 4.4.3 CNG cylinders are subject to failure, but not to BLEVE's (Boiling Liquid Expanding Vapor Explosion) because they do not contain liquid.

4.5 Operational Guidelines

- 4.5.1 Leaks
 - A. Eliminate ignition sources.
 - B. Evacuate the area:
 - 1. Down-wind.
 - 2. Where the life hazard is the greatest.
 - 3. Expand evacuation as necessary.
 - C. Natural gas is lighter than air (2/3 as heavy) it will dissipate quickly.
 - 1. A fog line can be used to direct the flow and protect exposures.

D Control the leak:

1. Stop the flow - each vehicle has an emergency shut off.
2. The location is different on each vehicle, but it can be found by looking for the sign "Emergency Shut Off" on the outside of the vehicle.
3. The valve is a common gas valve - (1/4 turn to shut off). See Figure 28, Detail A.
4. Each CNG cylinder can be shut off individually by closing the cylinder valve clockwise on the top of the cylinder. Turn clockwise to close.

E. Stretch a line to protect occupants and members.

4.5.2 Fires

- A. Extinguish a fire by stopping the flow of gas.
- B. If the flow of Gas cannot be stopped do not extinguish the fire - let it burn.
- C. DO NOT apply water to CNG cylinders exposed to fire because this may cool the pressure relief device (PRD) resulting in it not activating. This can result in a catastrophic cylinder failure (high pressure gas rupture). Exploding cylinders can rocket.
 1. When a PRD activates, it will not reset/close. The gas in the cylinder will burn off. The result is often a jet fire which may go out and reignite several times.
 2. It may take 10-15 minutes for the high-pressure release to subside and up to 30 minutes to fully discharge, depending on the size of the tanks involved.
 3. Establish a minimum safe perimeter of 100-ft around the vehicle.
 4. PRD's are located on both ends of the cylinder. They may be vented up and sideways. Additional PRD's may be located in the bottom of a vehicle on the regulator. Always approach from 45° angle. (Diagram 1)
 5. If the CNG cylinders are not involved in the fire, proceed with normal extinguishment tactics.



Diagram 1

4.6 Other Considerations

4.6.1 Remember in a dual fueled vehicle we have all the problems associated with the other fuel - gasoline or diesel which could compound our problems.

4.7 Compressed Natural Gas Filling Stations

4.7.1 CNG vehicles are refueled at filling stations - CNG filling stations consist of a compressor, storage tanks and fueling components. Depending on its design, a filling station can service anywhere from 1 to 28 vehicles at a time.

4.7.2 Refueling systems are available in two types:

- A. Fast Fill - In the fast fill system natural gas is stored in storage tanks under high pressure (3600 PSI) by the use of a compressor. The vehicle is refueled directly from these storage tanks in approximately 2 to 5 minutes. See Figure 26.
- B. Time Fill Method - Under this system a vehicle is refueled directly off a gas compressor which is hooked up to a gas main. This method takes several hours to refuel a vehicle.

- 4.7.3 Fire protection found at CNG filling stations
- A. 20 pound dry chemical extinguishers.
 - B. Heat or ultraviolet fire detectors.
 - C. Automatic shut off for gas supply.
 - D. Manual shut off for gas supply. This valve is a typical 1/4 turn gas valve and it is plainly marked.
 - E. Pressure relief device for storage tanks:
 - 1. Fusible plug set for 212 degrees Fahrenheit.
 - 2. Burst disk set for 4700 PSI.
 - F. In addition, Halon extinguishing systems or deluge water extinguishing systems may be found on some systems.
- 4.7.4 Operational guidelines as stated in section 3.5 shall also apply for fires and emergencies occurring at CNG filling stations.

Figure 25

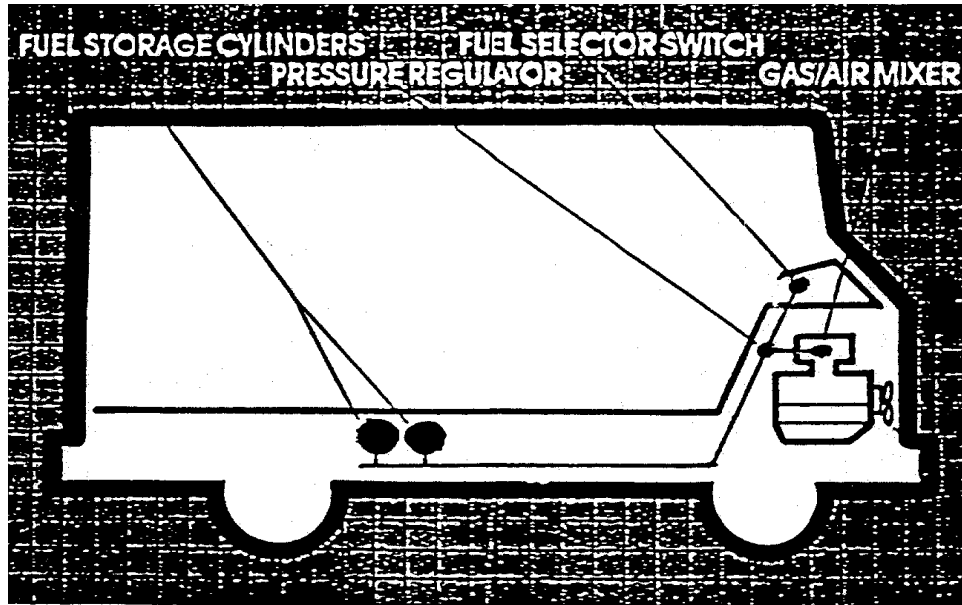


Figure 26

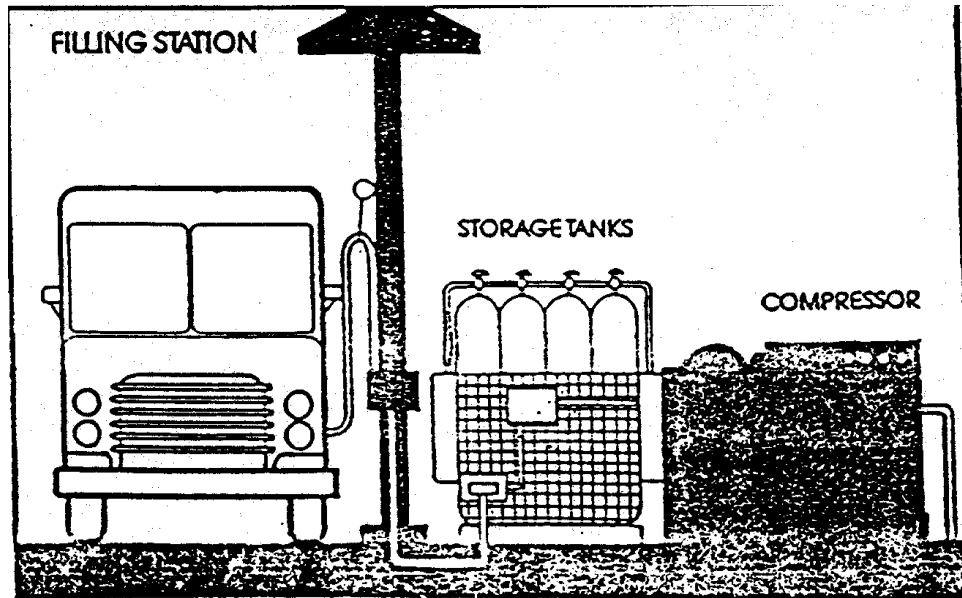
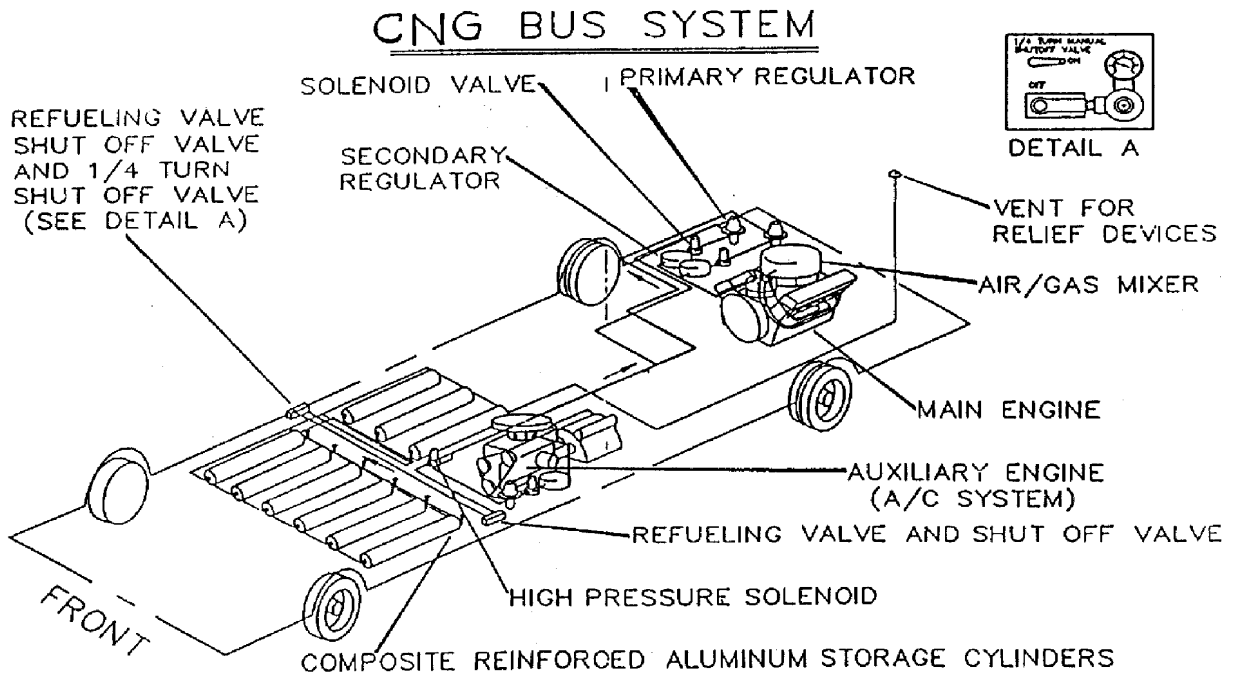


Figure 27



Figure 28



5. METHANOL FUELED VEHICLES

5.1 Introduction

5.1.1 New York City Transit Operators, both MTA and private, no longer have methanol fueled buses in operation. There is however a possibility that these types of vehicles will enter New York City from other jurisdictions.

5.2 Properties

5.2.1 Methanol is a highly volatile flammable liquid.

5.2.2 It has a flash point of 54 F.

5.2.3 It is soluble in water.

5.2.4 Methanol vapors are slightly heavier than air and will flow along the ground collecting in low areas.

5.2.5 Methanol burns cleanly (little smoke) and its pale blue flame may be difficult to see in bright sunlight.

5.3 Health Hazard

5.3.1 Methanol is both an eye and skin irritant.

5.3.2 Inhalation of vapor at high concentration can produce drunkenness, drowsiness, blurred vision and unconsciousness or death.

5.3.3 The effects of methanol exposure may be delayed 24 hours or longer.

5.4 Operational Guidelines

5.4.1 Spills/Leaks

A. Eliminate ignition sources in the immediate area and down-wind of the spill

B. Evacuate the area:

1. Down-wind.
2. Where the life hazard is the greatest.
3. Expand evacuation as necessary.

- C. Approach from up-wind.
- D. Use fog stream to channel vapors away from possible ignition sources. Fog stream will absorb and dilute vapors. Apply down-wind of the spill to be most effective.
- E. Prevent liquid from entering sewers, manholes, subway gratings, cellars etc.
- F. Dike spills with sand, dirt or other material.
- G. On cool days when the ambient temperature is below the flash point of 54 degrees Fahrenheit the danger of fire and explosion is reduced and delayed. It is important to keep the spill as cool as possible.
- H. Blanket pools of liquid with alcohol foam to inhibit vapor generation.

5.4.2 Fires

- A. Methanol is destructive to ordinary foam. Alcohol type foam must be used. For small fires Type B dry chemical extinguishers are adequate. Purple K is the most effective of the dry chemical extinguishing agents.
- B. Application of large amounts of water will dilute the Methanol rendering it non-flammable. The concentration of methanol must be reduced below 20% to be effective. Adequate water supply must be available. Run-off should be contained by diking or other means to prevent entry into sewers and to assist in the dilution.
- C. It is important to remember that a methanol fire may be invisible during day light hours. Proceed with caution when establishing the boundary of the fire.

BY ORDER OF THE FIRE COMMISSIONER AND CHIEF OF DEPARTMENT